

ORIGINAL RESEARCH

Does wearing a surgical mask influence face touching by healthcare workers? A retrospective cohort study

Anil JOSHI,¹ Yannan JIANG² and Peter JONES ^{1,3}¹Adult Emergency Department, Auckland City Hospital, Auckland District Health Board, Auckland, New Zealand, ²Department of Statistics, The University of Auckland, Auckland, New Zealand, and ³Department of Surgery, The University of Auckland, Auckland, New Zealand

Abstract

Objective: At the start of the COVID-19 pandemic, healthcare workers (HCW) in our ED were advised against and actively discouraged from wearing masks when not seeing respiratory patients, as mask wearing was thought to increase the risk of droplet transmission by face touching. The primary objective of the present study was to determine whether HCW using face masks were more or less likely to touch their faces than those not wearing masks.

Methods: We analysed six randomly selected hours of closed circuit television footage from our staff base. Face touches were recorded electronically by trained researchers. Generalised linear mixed models were used to compare the frequency and duration of face touches with and without face masks, controlling for individual clusters, adjusting for time of footage, duration on screen and staff role.

Results: Data were collected from 187 HCW. Masks were worn in 231 (36%) of 642 screen sessions. Wearing a mask did not significantly change the odds of face touching (odds ratio 0.55, 95% confidence interval [CI] 0.30–1.01, $P = 0.055$) or duration of face touch (mean difference -1.45 s, 95% CI -8.84 , 5.99 , $P = 0.71$). For

mucosal areas, a significant reduction in the odds of face touching was observed for mask wearers (odds ratio 0.21, 95% CI 0.11–0.43, $P < 0.001$) and on the frequency of mucosal touches (rate ratio 0.45, 95% CI 0.29–0.69, $P < 0.001$).

Conclusions: Mask wearing did not change face touching or the duration of face touches. However, significantly fewer mucosal touches were observed when wearing a mask, which may help to reduce nosocomial droplet transmission of viruses.

Key words: face, mask, nosocomial infection, touch.

Introduction

The coronavirus disease 2019 (COVID-19) pandemic has required an unprecedented and large-scale response with multiple policy and procedural adaptations, including within the healthcare sector. Wearing face masks in the community has been highly publicised and contested since the emergence of COVID-19.¹ The COVID-19 virus has been shown to remain viable in the air for several hours and on surfaces up to days,² and such aerosols are blocked by surgical masks in laboratory experiments.³ Although initially slow

Key findings

- Mask wearing does not increase face touching by ED staff.
- Mask wearing reduces touching of mucosal areas of the face.

to encourage mask wearing during the initial phases of the pandemic, the Ministry of Health in New Zealand (NZ) subsequently mandated mask wearing for all employees and customers at public-facing businesses, and on public transport.⁴

Despite systematic review evidence and economic analysis to support the use of masks in the community from previous viral pandemics,^{5–7} there continues to be variable interpretation of this evidence by different policy makers.⁸ Some have raised concerns that using masks may increase face touching, therefore increasing risk of infection through self-contamination through the hand-face route, including the World Health Organization (Appendix S1).

Healthcare workers' (HCW) risk for acquiring nosocomial infection is well documented. In previous severe acute respiratory syndrome outbreaks, around one-fifth of cases were HCW,⁹ and during the current pandemic, 11% of all cases have been in HCW, both overseas¹⁰ and in NZ.¹¹ The NZ Ministry of Health and District Health Boards initially advised that wearing surgical masks may increase facial touching and hence the risk of viral contamination of masks if worn for general use (Appendix S1). At the start of the pandemic in March 2020, ED staff in Auckland City Hospital (ACH) were advised not to wear masks

Correspondence: Associate Professor Peter Jones, Department of Surgery, The University of Auckland, Park Road, Grafton, Auckland 1023, New Zealand. Email: peterj@adhb.govt.nz

Anil Joshi, MBChB, Emergency Medicine Specialist; Yannan Jiang, PhD, Biostatistician; Peter Jones, PhD, Director of Emergency Medicine Research.

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when seeing low-risk patients or in general use. Later, this policy changed such that staff were allowed to wear a mask at their own discretion. Finally, in mid-2020, staff were 'strongly encouraged' to wear masks during clinical duties with patients and also in the staff base where socially distancing was more difficult. Consequently, mask wearing increased from July 2020. The ambiguity and anxiety around the dynamic policies provided a unique opportunity to study the rate of facial touching, by HCW wearing or not wearing a mask in a real-world setting.

There is limited literature on the frequency of facial touching behaviour as a potential vector for self-inoculation and transmission of respiratory viruses. These have been based on the observing the general public,¹² medical students and HCW in a lecture theatre^{13,14} or staff in respiratory wards¹⁵ rather than in an ED setting in the context of an evolving pandemic.

As there was little to no evidence to inform the question whether masks altered the amount of face touching by HCW when not directly seeing patients with respiratory illness, or how they alter the rate of face touching, we set out to answer this question. The primary aim was to determine the number of face touches when ED staff were and were not wearing masks. The secondary aims were to determine the number of touches of mucosal areas of the face and the duration of touches.

Methods

Setting

This was a retrospective observational cohort study of HCW in a single ED during the COVID-19 pandemic in 2020–2021. The Adult ED, at ACH is a tertiary urban academic hospital in Auckland, NZ. The ED sees approximately 76 000 adult (≥ 15 years) patients annually. There are over 200 staff employed in the ED, with approximately 30 staff in different roles on rotating shifts over a 24-h period.

Data collection

As part of routine security precautions, the ED is monitored continuously using closed circuit television cameras. Video footage is usually stored securely for a period after collection and then destroyed. We analysed this routinely collected video data. Randomly selected footage was selected from the study periods on 19 April to 20 June 2020 and 1 February to 31 March 2021, spanning the pandemic and a variety of lockdowns and mask wearing policies. Numbers representing hours were chosen at random using the random number generation function in Microsoft Excel, from the range 0–Y ($Y = 24$ h multiplied by days of footage) to identify which hours of video footage were analysed.

Sample size

Based on the data from previous studies, with a rate of face touching between 10 and 25 times per hour per person and 30 staff per shift present in the department, we estimated that there would be approximately 300–750 facial contacts per hour. Although it is not known what a clinically important difference in facial touching is, we have assumed five touches per hour per session as a meaningful difference. This is a 20–50% absolute reduction based on prior studies.^{13,15} We estimated that up to 6 h of footage may be required to obtain sufficient data to determine this difference. A post hoc power calculation based on the study sample gave 90% power at 5% level of significance to detect an odds ratio (OR) of 0.6 assuming a control rate (likelihood of face touch without a mask) of 0.5.

Ethics

We contacted all staff in the ED through work email to inform them of the study and give them the option to opt out of the study, in which case the rate of facial touching by those staff would not be included in the study data collection. No staff opted out of the study. Only aggregate, anonymous data was reported to maintain confidentiality. The

study was approved by the Auckland Health Research Ethics Committee (reference: AH2647) and the Auckland District Health Board Research Review Committee (A+8911).

Data handling

Using a standardised electronic data collection form (Microsoft Excel, Redmond, WA, USA), the number of mask wearers compared to non-mask wearers and the frequency and location of hand-to-face contact were tallied.

Source data (footage) was obtained from ACH security using a password secured hard drive. The footage was observed and included the following variables: staff role; mask worn or not; screen duration; count of face touching; and site of touch. Areas of the face were designated as the forehead, temple, ears, eyes, nose, mouth, chin and cheeks, as shown in Table 1. Sites were subsequently categorised into mucosal (eyes, mouth and nose) and non-mucosal (other areas of the face). Any touch of the face was counted, with the duration determined by the time in seconds from the start to finish of the face touch. Touches briefer than 1 s were counted as 1 s for the purpose of analysis. Patients and pre-hospital personnel were excluded. Donning and doffing personal protective equipment (PPE) or using a mobile or fixed line telephone were not counted as a face touch.

Data were obtained by trained researchers who initially observed footage together to calibrate data collection processes, including what counted as a face touch and which area of the face was being touched. This was done to mitigate any observer bias because of individual differences in individual's interpretations. We independently checked 10% of records for agreement on whether there were face touches or not, with a kappa of 0.96 (0.88–1.0) indicating near perfect agreement. Where errors in data entry were detected, such as incorrectly entered start or stop times leading to negative or very prolonged face touch durations, footage was analysed independently by a second researcher and errors corrected.

TABLE 1. Frequency, duration and site of face touches during screen sessions

Screen sessions (<i>n</i> = 642)	No mask (<i>n</i> = 411)	Mask (<i>n</i> = 231)
Face touch		
No	230 (56.0%)	138 (59.7%)
Yes	181 (44.0%)	93 (40.3%)
Number of face touches	1.6 (3.6)	1.3 (2.5)
Duration of face touch (s)	10.7 (41.2)	7.8 (31.3)
Mucosal touch		
No	293 (71.3%)	197 (85.3%)
Yes	118 (28.7%)	34 (14.7%)
Number of mucosal touches	0.8 (2.1)	0.3 (0.8)
Duration of mucosal touch (s)	5.1 (3.3)	1.0 (4.1)
Site of face touch		
Temple/forehead	95 (23%)	48 (21%)
Ears	49 (12%)	28 (12%)
Chin	41 (10%)	19 (8%)
Cheek	33 (8%)	14 (6%)
Eyes	21 (5%)	14 (6%)
Mouth	70 (17%)	7 (3%)
Nose	103 (23%)	25 (11%)
Mask adjustment	—	76 (33%)

Data are reported as *n* (%) and mean (standard deviation).

Data analysis

Full footage data were imported to SAS version 9.4 (SAS Institute, Inc., Cary, NC, USA) for analysis. A screen session was defined by each HCW screen start and end time (duration on screen). The frequency and duration of face touch were calculated for each screen session when the HCW had face mask and no mask, respectively. Descriptive summaries were presented on the session data using mean, standard deviation, median and interquartile range (IQR) for continuous variables and frequencies (*n*) and percentages (%) for categorical variables.

Generalised linear mixed models were used to compare the frequency and duration of face touch between screen time with and without face mask, taking into account the cluster effect of individuals with repeated sessions. As screen duration varied per HCW and mask use varied between groups of HCW and

between time periods, all regression models adjusted for the period of footage, HCW type and screen duration. Binary outcomes were analysed using binomial distribution with a logit link and reported as OR with 95% confidence intervals (CI). The rate ratio (RR) was reported on the counts (i.e. frequency of face touches) using Poisson distribution, and the mean difference (MD) was reported on continuous outcomes using normal distribution. Statistical tests were two-sided at 5% level of significance.

Results

Participants

Data were collected from 187 HCW on a total of 642 screen sessions. The study sample included 99 (53%) nurses, 50 (27%) doctors and 38 (20%) other staff. A description of the sample is shown in Table 2.

HCW other than doctors and nurses were more likely to wear masks

during screen sessions (103/177, 58.2% [95% CI 51–65]) compared to doctors (42/113, 37.2% [95% CI 29–46]) and nurses (86/352, 24.4% [95% CI 20–29]).

Screen duration

The total duration of staff time on screen was 45.8 h, 25.2 h for nurses, 12.0 h for doctors and 8.6 h for other HCW. Total screen duration was 17.3 h for mask wearers and 28.5 h for those not wearing masks. The median (IQR) duration per session was 88 (23–316) s, with the duration for mask wearers 87 (22–345) s and non-wearers 90 (25–303) s, respectively.

Face touching

Table 1 shows the outcome data for face touching with or without wearing a mask during screen sessions (*n* = 642). The median (IQR) number of face touches per session was 0 (0–1), with a maximum of 29. The median (IQR) duration of face touches was 0 (0–3) s, maximum 536 s. The median (IQR) number of mucosal touches was 0 (0–0), maximum 22. The median (IQR) duration of mucosal touches was 0 (0–0), maximum 502 s. Sites of face touching were similar for mask wearers and non-wearers, other than a reduction in touching the mouth and nose when wearing a mask, which was countered by mask adjustment (Table 1).

In adjusted regression analysis, the odds of any face touch with a face mask on was lower than that without a mask, although this was not statistically significant (OR 0.55, 95% CI 0.30–1.01, *P* = 0.055). A statistically significant reduction was found on the odds of HCW touching a mucosal area of their face while wearing a mask compared to not wearing a mask (OR 0.21, 95% CI 0.11–0.43, *P* < 0.001; Table 3).

Overall, the number of face touches per session did not differ for those wearing and not wearing masks (RR 0.92, 95% CI 0.70–1.21, *P* = 0.57). The number of mucosal touches per session, however, was significantly lower for mask wearers (RR 0.45, 95% CI 0.29–0.69, *P* < 0.001).

TABLE 2. Description of sample based on screen sessions

	Screen sessions		
	All (<i>n</i> = 642)	No mask (<i>n</i> = 411)	Mask (<i>n</i> = 231)
Footage period			
2020			
1	136 (21.2%)	100 (24.3)	36 (15.6)
2	78 (12.1%)	60 (14.6)	18 (7.8)
3	75 (11.7%)	73 (17.8)	2 (0.9)
4	120 (18.7%)	120 (29.2)	—
2021			
5	134 (20.9%)	24 (5.8)	110 (47.6)
6	99 (15.4%)	34 (8.3)	65 (28.1)
Healthcare worker			
Nurse	352 (54.8%)	266 (64.7)	86 (37.2)
Doctor	113 (17.6%)	71 (17.3)	42 (18.2)
Orderly	81 (12.6%)	36 (8.8)	45 (19.5)
Administrator	58 (9.0%)	27 (6.6)	31 (13.4)
Other	38 (5.9%)	11 (2.7)	27 (11.7)
Duration on screen per session (s)	88 (23–316)	90 (25–303)	87 (22–345)

Data are reported as *n* (%) and median (interquartile range).

The duration of face touching did not differ between mask wearers and non-wearers, with an overall MD of -1.43 s (95% CI -8.84 , 5.99 , $P = 0.71$). Similar results were found on the duration of mucosal touching (MD -1.50 , 95% CI -6.00 , 2.99 , $P = 0.51$).

Discussion

In the present study, we found that wearing a face mask did not alter whether or how often HCW in our ED touched their faces, with the absolute difference in any face touch being less than 4%, which is unlikely to be clinically important. The duration of face touching also showed no difference. However, when a mask was worn, the odds of a HCW touching a mucus membrane and the number of mucous membrane touches were significantly reduced compared to not wearing a mask. The absolute difference in mucosal touches was 14%, which may be clinically important.

The likely explanation for the reduced frequency of mucous

membrane touches is the physical barrier that the face mask provides to the nose and mouth, thus reducing the opportunity to touch these high-risk zones for viral transmission. We did not count 'mask adjustment' as a mucosal touch, although it was counted as a face touch. A recent systematic review found that even in high-risk clinical areas during prolonged use, there is little virus carriage on HCW face masks.¹⁷

We found that some HCW touched their faces a lot while many did not touch their face often, if at all. HCW understanding of their own predisposition to facial touching may be important with respect to their risk of nosocomial infection.

Subsequent to the design and conduct of our study, several other studies relevant to this issue have been published. Lucas *et al.* compared face touching among 40 HCW with and without masks in the setting of a teaching session in a conference room.¹⁴ They found that those without masks touched their faces nearly four times as often as those who wore masks.

However, it may be that the individuals in this study who chose to wear a mask may be those who are naturally less likely to touch their faces, so there was a risk of selection bias. We anecdotally noted less face touching by early adopter mask wearers during the first period of observation in our study. Chen *et al.* compared face touching behaviours before and after the start of the pandemic in a cross-sectional study of more than 7500 promotional or tourism videos gathered from 'YouTube' and other websites of individuals in countries where mandatory mask wearing policies were enacted.¹² They reported that mask wearing resulted in a dramatic difference in face touching of mucosal areas. Shiraly *et al.* found both face touching and mucosal area touching was less for 1000 people in public spaces wearing face masks.¹⁸ Liebst *et al.* found both face touching and mucosal area touching was less for 804 people in public spaces wearing face masks.¹⁹ Perez-Alba *et al.* found no difference in face touches per hour in video analysis of 98 patients waiting in an

TABLE 3. Regression analysis on study outcomes†

	Unadjusted estimates (n = 642)		Adjusted estimates (n = 642)	
	OR (95% CI)	P	OR (95% CI)	P
Any face touch	0.78 (0.50–1.20)	0.26	0.55 (0.30–1.01)	0.06
Mucosal touch	0.37 (0.23–0.60)	<0.001	0.21 (0.11–0.43)	<0.001
	Unadjusted estimates (n = 642)		Adjusted estimates (n = 642)	
	RR (95% CI)	P	RR (95% CI)	P
Number of face touches	0.71 (0.57–0.87)	0.001	0.92 (0.70–1.21)	0.57
Number of mucosal touches	0.36 (0.25–0.51)	<0.001	0.45 (0.29–0.69)	<0.001
	Unadjusted estimates (n = 642)		Adjusted estimates (n = 642)	
	MD (95% CI)	P	MD (95% CI)	P
Durations (s)				
Duration of face touch	−6.65 (−13.78, 0.47)	0.07	−1.43 (−8.84, 5.99)	0.71
Duration of mucosal touch	−3.94 (−8.09, 0.20)	0.06	−1.50 (−6.00, 2.99)	0.51

†Generalised linear mixed models controlled for the cluster effect of healthcare workers (HCW). The adjusted analysis included the period of footage, HCW type and screen duration. CI, confidence interval; MD, mean difference; OR, odds ratio; RR, rate ratio.

infectious disease clinic in an unadjusted analysis²⁰ and Tao *et al.* also found no difference in face touching by 61 bus passengers before and after a mask wearing mandate in a video analysis.¹⁶ Although the settings and/or participants were different to our study, these studies support our findings, of at worst no more face touching while wearing a mask and at best a reduction in face or mucosal touching. In contrast, Kungurova *et al.* personally observed 468 people in a city centre for 5 min in real time (not analysing video). They reported in a simple descriptive analysis that mask users were more likely to have touched their face at least once in the 5-min observation period than non-mask users (16.5% *vs* 5.8%) and reported anecdotally that mask wearers seemed to touch their face more often.²¹

Limitations

Our study has several limitations. We did not study each individual HCW with and without a mask, as it was not possible with the current study design. This means we cannot say whether mask wearing alters a

particular individual's face touching habits. Selection of earlier time periods when masks were infrequently used meant that HCW may have been less concerned about risk of infection based on the level of community spread. We aimed to mitigate this by also choosing a later time period with heightened concern about COVID-19 in the community and more mask wearing. Time period was also included as a potential confounder in the adjusted analysis. Another limitation was the potential for inter-observer variability in data collection. Following individuals on screen in the busy work environment of the ED was challenging and there was potential for miscounting face touches or misinterpreting which part of the face was touched. The study was not blinded (by necessity) and the data collectors were aware of the study aims, therefore the observer's bias with respect to favouring or not favouring mask use may have influenced their data input. We mitigated the latter by training data collectors together to calibrate what should or should not be counted as a touch. This was a single site study in an adult ED in NZ with a low/zero prevalence

of COVID-19 community infection during the study period, so it is not clear whether these results may be generalised to other clinical settings especially when there is a much higher prevalence of COVID-19.

Conclusions

Mask wearing among HCW made no difference to whether HCW touched their face or the number and duration of face touches. However, there were fewer mucosal touches when wearing a mask, which may help to reduce nosocomial contact transmission of viruses.

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Author contributions

AJ: literature search, study design funding acquisition, data collection, data curation, data interpretation, writing – original draft. YJ: study design, data curation, formal analysis, data interpretation, writing – review and editing. PJ: study concept, design, literature search, funding acquisition, data collection, data curation, data interpretation, supervision, writing – review and editing.

Competing interests

PJ is a section editor for *Emergency Medicine Australasia* and was excluded from the peer-review process and all editorial decisions related to the acceptance and publication of this article. Peer review was handled independently by members of the Editorial Board to minimise bias.

Data availability statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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Supporting information

Additional supporting information may be found in the online version of this article at the publisher's web site:

Appendix S1. Masks and face touching advice to healthcare workers April–August 2020.